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6. ANALYSIS: ECOREGION 68

This section presents an assessment of the geographical applicability of an existing criterion (Ecoregion 69) to a different ecoregion (Ecoregion 68) using the background-matching approach (Section 3.6). Under this approach, background conductivity of the Ecoregion 68 is estimated at the 25th centile of probability samples (Section 3.6.2.1, and Cormier and Suter 2013a) and compared to the background estimates for Ecoregion 69 and 70 (Sections 4.2.2 and 5.2.2). Confidence intervals (CI) were estimated using a bootstrapping technique (Section 3.6.1.1). Because this is the first demonstration of applicability of an existing criterion to a new ecoregion, the approach was verified as reliable by independently deriving an HC_{05} for Ecoregion 68 and comparing it to the results of the background-matching approach (Section 6.4).

6.1. ECOREGION 68: DATA SET CHARACTERISTICS

Ecoregion 68 extends from Kentucky to Alabama and is bordered by the Western Allegheny Plateau (70) to the north and Central Appalachians (69) to the northeast. Escarpments demarcate the boundaries between the Interior Plateau (71) to the west and the Ridge and Valley (67) to the east. Its underlying geology is mostly interbedded limestone, sandstones, siltstones, shale, and coal (Woods et al., 2002). Moderate to high gradient streams have cobble- or boulder-dominated substrates; whereas, low gradient streams have gravelly or sandy bottoms (KDOW 2013). Coal mining occurs in several parts of the region. Its low mountains, hills, and intervening valleys are primarily forested with some cropland and pasture. Upland forests are dominated by mixed oaks with shortleaf pine. Mixed mesophytic forests are found mostly in the deeper ravines and on escarpment slopes (U.S. EPA 2010).

No new data were collected for this assessment. Two independent data sets, an EPA-combined data set and a State-combined data set, were used to characterize ion concentrations and water chemistry in Ecoregion 68.

Because the draft recommended conductivity criteria were developed for an ionic mixture dominated by bicarbonate and sulfate (i.e., ($[HCO_3^-] + [SO_4^{2-}]) > [Cl^-]$ in mg/L), samples dominated by chloride (i.e., ($[HCO_3^-] + [SO_4^{2-}]) \leq [Cl^-]$ in mg/L) were removed from the data set prior to estimating background conductivity (for Ecoregions 69 and 70). In this case (for Ecoregion 68), no samples were dominated by Cl^- and so all samples were used in the EPA-combined data set. In the validation data set (State-combined dataset), Cl^-, SO_4^{2-}, and HCO_3^- measurements were reported for only two samples. Therefore, it is assumed that the ionic mixture is the same as the original EPA-combined data set.

6.1.1. EPA-combined Data Set

The primary sources of the EPA-combined data used to estimate background conductivity in Ecoregion 68 for the purpose of assessing applicability (of Ecoregion 69 or 70 conductivity criteria to Ecoregion 68) are listed in Table 6.1. The National Rivers and Streams Assessment (NRSA, 2008−2009), Wadeable Stream Survey (WSS, 2004), Environmental Monitoring and Assessment Program (EMAP, 1993−1998), Regional-EMAP (R-EMAP, 1999), and National Acid Precipitation Assessment Program (NAPAP) (1987) data sets are based on single random (i.e., probability-based design) samples from June through September.

EPA-combined data sampling sites within Ecoregion 68 are shown in Figure 6.1. Data sources, sampling period, and number of samples for Ecoregion 68 sites are provided in Table 6.1. Water quality parameters collected in Ecoregion 68 are included in Table 6.3. Most of the samples have reported conductivity, alkalinity, hardness, sulfate, chloride, bicarbonate, and pH, as well as other water quality parameters. When necessary, ionic concentrations in milliequivalents (meq/L) were converted to mg/L [(meq/L) × (ion MW) / (ionic charge)] (Hem 1985).

All samples were collected from first- through fourth-order streams as part of a probability-based design intended to estimate proportions of parameters for various stream classes. These sampling weights for stream order were not used in the characterization. Analysis of water chemistry samples followed procedural and QA/QC (quality control) protocols of EPA and EMAP protocols (U.S. EPA, 1987, 1994, 1998, 2001), Wadeable Stream Assessment (WSA; U.S. EPA, 2004a, b), and NRSA (U.S. EPA, 2009), and NAPAP (Drousé et al., 1986; U.S. EPA, 1987).

Table 6.1. Description of data sets (data sources, sampling period, and number of samples) combined to form the EPA-combined data set used to estimate background conductivity in Ecoregion 68. There are no replicates in this dataset.

Ecoregion	**Data set**	**Sampling period**	**Total *N***	**AL**	**GA**	**TN**
EPA-combined data set for Ecoregion 68	NAPAP	1986	27	12		15
	Region 4 Wadeable Streams R-EMAP	1999−2002	9[a]	6	1	2
	WSA	2004	6	5		1
	NRSA	2008−2009	4	3		1
		TOTAL	46	26	1	19

[a] Only specific conductivity was measured in this survey.

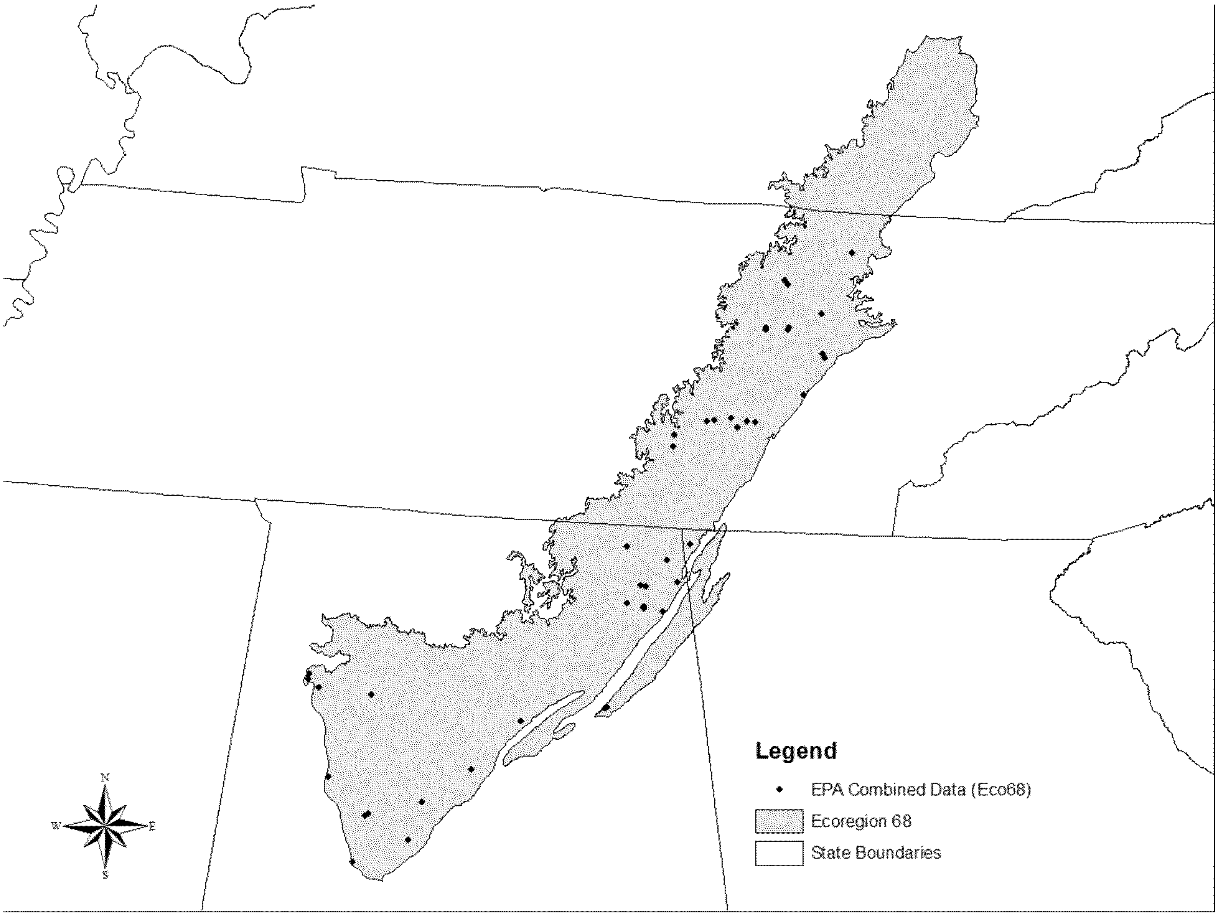

Figure 6.1. Sampling sites in the EPA-combined data set that were used to estimate background for Ecoregion 68 are indicated as points. Ecoregion 68 extends from southern Kentucky, across Tennessee, and into northern Alabama. Ecoregion 70 is to the north and ecoregion 69 lies to the northeast. A total of 46 sampling sites are depicted.

6.1.2. State-combined Data Set

The primary sources of the State-combined data used to estimate background conductivity and to verifying the results of the background-matching method (by deriving an HC_{05} for Ecoregion 68) are listed in Table 6.2. The locations of sampling points are depicted in Figure 6.2. Water quality parameters are listed in Table 6.3. This second data set for Ecoregion 68 was constructed to validate the initial analyses of background conductivity estimated using the EPA-combined data set. It was also used to verify the approach as reliable by independently deriving an HC_{05} for Ecoregion 68 and comparing it to the results of the background-matching approach (Section 6.4).

Table 6.2. Description of data sets (data sources, sampling period, and number of samples) forming the state-combined data set to estimate background conductivity and estimate HC_{05} for verification of the approach.

Ecoregion	Data set	Sampling period	Number of sites[a]	Number of samples
State-combined data set for Ecoregion 68	Kentucky Division of Water (KDOW)	1998-2004	39	39
	Tennessee Division of Water Pollution Control (TDWPC)	1996-2010	79	169
	Alabama Department of Environmental Management (ADEM)	2002-2004	70	86
		Total *N*	188	294

[a] About 36% total samples are replicated samples (106/294); about 75% sites were resampled once and 25% were resampled more than once.

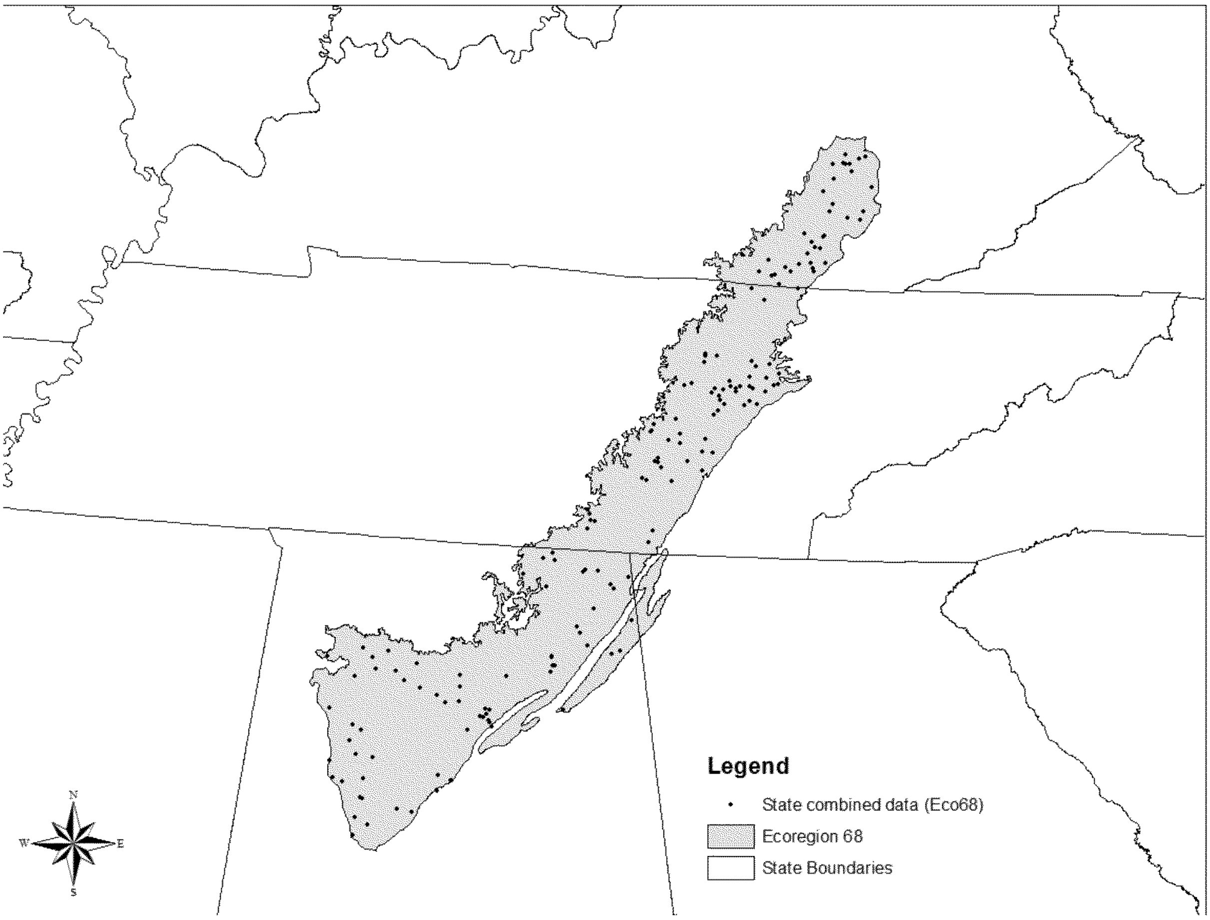

Figure 6.2. Sampling sites in the State-combined data set that were used to estimate background for Ecoregion 68 are indicated as points. Ecoregion 68 extends from southern Kentucky, across Tennessee, and into northern Alabama. Ecoregion 70 is to the north and Ecoregion 69 lies to the northeast.

6.1.2.1. *Kentucky Division of Water (KDOW) Data Set*

Data were obtained from the Kentucky Division of Water, Water Quality Branch database, Ecological Data Application System (KY EDAS). Chemical, physical, or biological samples were collected from 274 distinct locations during February−October from 1998−2004 (see Appendix G-1 in *EPA Benchmark Report*, U. S. EPA 2010a). Of these, 39 samples from Ecoregion 68 in wadeable streams had biological and conductivity data. The KDOW obtains biological data from both probability biosurvey and targeted ambient biological monitoring programs. The probability biosurvey program provides a condition assessment of the overall biological and water quality conditions for both basin and state levels. Targeted ambient biological monitoring involves intensive data-collection efforts for streams of interest as reference or impaired sites or for other reasons. Most sites were sampled once between February and October. Quality assurance and standard procedures are described by KDOW (2008). Macroinvertebrates are collected from mid-riffle/runs. Although KDOW also collects a separate sample from multihabitat surveys, for consistency, only the riffle sample is quantified for this analysis. Four, 0.25-m^2 samples are collected mid-riffle in a 100-m sampling reach using a 1-m-wide, 600-µm mesh net. The four samples are composited, and all macroinvertebrates are removed and stored in 95%-ethanol. Samples are composited, and macroinvertebrates are identified to the lowest possible taxonomic level. KDOW identifies 300 $\pm$ 20 organisms.

All contracted chemical analyses and macroinvertebrate identifications followed internal quality control and quality assurance protocols (KDOW 2008). This is a well-documented, regulatory database. The quality assurance was judged to be excellent based on the database itself, supporting documentation, and professional judgement.

6.1.2.2. *Tennessee Division of Water Pollution Control (TDWPC) Data Set*

Data were obtained from the Tennessee Division of Water, Pollution Control Division. The TDWPC conductivity data were collected concurrently while collecting biological data from both probability biosurvey and targeted ambient biological monitoring programs for first- through fifth-order streams. The sampling season occurred during both winter−spring (January −June) and summer−autumn (July−December) index periods (1996−2010). A total of 169 samples were collected during this period. The probability biosurvey program provides an overall condition assessment of the biological and water quality for both basin and state levels. Targeted ambient biological monitoring involves intensive data collection efforts for streams of interest as reference or impaired sites or for other reasons. Quality assurance and standard procedures are described in Tennessee Department of Environmental Conservation (TDEC) (2006).

Macroinvertebrates are collected from each site using one of three methods, depending on the presence of riffles and the width of the stream. For streams with riffles $\geq$1 m wide, two riffle kicks are performed and composited using a 2-person, 1-m^2, 500-µm mesh kick net; one in a high velocity riffle and one in a lower velocity riffle. For each riffle kick, a 1 m^2 area of substrate one meter upstream of the net is thoroughly disturbed and allowed to flow into the kick net. For streams with riffles less < 1 m wide, four separate riffles are sampled and composited using an 18-inch, 500-µm mesh rectangular dip net. For each riffle, an area of substrate approximating the dimensions of the net is thoroughly disturbed and sampled. For streams with no riffles, a triangular, 500-µm mesh dip net is used to sample three bank undercut areas by thoroughly agitating each area with the net to dislodge invertebrates. The three samples are then composited. Concurrent chemical and physical measurements are collected within 200 m of the macroinvertebrate collections, within the same stream reach. For all three biological sampling methods, samples are preserved in ethanol and transported to the laboratory, where 200 individuals from each sample are randomly selected and identified using a gridded subsampler.

All protocols and QA/QC procedures were performed according to the TDEC (2006) Quality System Standard Operating Procedure. This is a well-documented, regulatory database. The quality assurance was judged to be excellent based on the database itself, supporting documentation, and professional judgment.

6.1.2.3. *Alabama Department of Environmental Management (ADEM) Data Set*

The ADEM conductivity data were collected with biological data for a targeted ambient biological monitoring program in first- through fifth-order streams (ADEM 2012). All monitoring activities conducted on wadeable rivers and streams were coordinated under ADEM’s Rivers and Streams Monitoring Program (RSMP) (ADEM 2008, 2010c). Four types of wadeable, flowing sites were monitored, including probabilistic sites, ecoregional reference sites, targeted and intensive survey sites, and ambient trend sites. Additional water quality samples were collected independently of the biological sampling. The benthic sampling season was April through July. The program was designed to target streams throughout the state, with even spatial distribution, for assessing specific streams and for general conditions.

In Ecoregion 68 of Alabama, the Southwestern Appalachians, data from 220 samples in 120 first- through fifth-order stream sites were provided by ADEM collected from 1991-2010. Of those, 86 samples from 70 sites had concurrent macroinvertebrate and conductivity values. Conductivity data were collected with multi-probe meters in the field. Physical water quality, nutrients, metals, coliform bacteria, and atrazine were also measured in several sites using field meters and laboratory-analyzed samples.

Benthic macroinvertebrate samples were collected by ADEM using their wadeable multihabitat benthic intensive (WMB-I) protocols (ADEM 2012, ADEM 2010a). These protocols specify kick-net methods to collect several samples at a site by stream habitat type, separate processing of each sample, and recombination of the taxa lists after standardizing individual counts to density units. Habitats routinely sampled using this method include riffles, leaf packs, rootbanks, snags/logs and rocks, and sand.

ADEM’s regulatory data base is well-documented. All protocols and QA/QC procedures for chemical and biological sampling were performed according to the ADEM (2008, 2010c), respectively. The quality assurance was judged to be excellent based on the database itself, supporting documentation, and professional judgment.

6.2. RESULTS—ECOREGION 68

6.2.1. Ionic Mixture—Ecoregion 68

A summary of water quality ionic constituents including major ionic constituents for Ecoregion 68 is listed in Table 6.3. Centiles are calculated using each sample observation rather than mean of site measurements. There were no chloride-dominated sites (where [Cl^-] > [HCO_3^-]+[SO_4^{2-}]) in either the EPA-combined (N = 46) or State-combined data set (samples with ionic measurements, N = 2); therefore, no sites were excluded sites from the data set. Background conductivity was estimated from the full EPA-combined data set and validated with the full State-combined data set.

Table 6.3. Summary of water quality parameters for EPA- and State-Combined Data Sets for Ecoregion 68.

Ecoregion	Ion or Conductivity	Min	-centile				Max	Number of samples
			10th	25th	50th	75th		
EPA-combined data set Ecoregion 68	HCO_3^- (mg/L)	1.97	4.53	6.69	12.09	21.95	327.2	37
	SO_4^{2-} (mg/L)	1.59	2.79	3.69	6.06	9.89	1,262.5	37
	Cl^- (mg/L)	1.20	1.33	1.58	2.57	4.61	101.3	37
	Ca^{2+} (mg/L)	0.69	1.33	2.48	5.71	8.87	292.6	37
	Mg^{2+} (mg/L)	0.48	0.79	1.00	1.40	2.52	166.2	37
	Na^+ (mg/L)	0.56	1.04	1.37	1.74	2.68	226.1	37
	K^+ (mg/L)	0.46	0.65	0.77	0.94	1.75	4.9	37
	pH (SU)	6.09	6.35	6.72	6.99	7.40	8.8	46
	[b]$(HCO_3^- + SO_4^{2-}) / Cl^-$	2.09	2.42	4.07	5.74	14.99	1,065.3	37
	Conductivity (µS/cm)	17	25	45	67	123	3991	46
State-combined data set Ecoregion 68	HCO_3^- (mg/L)	2.44	6.1	14.7	34.6	99.8	347.6	140
	SO_4^{2-} (mg/L)	3	3.9	5.6	6.0	8.3	22.0	34
	Cl^- (mg/L)	1.00	2.30	3.55	5.19	9.34	237.29	59
	pH (SU)	6	6.38	6.73	7.19	7.60	8.60	294
	[b]$(HCO_3^- + SO_4^{2-}) / Cl^-$	12.4	13.3	14.6	16.9	19.1	21.4	2
	Conductivity (µS/cm)	12	26	43	88	218	1809	294

[a] Relevant *N* indicates the number of samples from the large data set relevant to each water quality parameter.
[b] Value within category calculated from individual sample ion concentrations.

6.2.2. Conductivity Background—Ecoregion 68

The rule-based determination of applicability ("background-matching method" in Section 3.6.1.1) was used to identify applicable criteria for conductivity in Ecoregion 68.

1. If the point-estimated background conductivity for Ecoregion 68 is <101µS/cm (upper confidence interval (CI) of estimated background conductivity for ecoregion 69), the criteria for Ecoregion 69 are applicable to Ecoregion 68.
2. If the point-estimated background conductivity for Ecoregion 68 is within102 and 135 µS/cm (between upper CI for the estimated background Ecoregion 69 and the lower CI for Ecoregion 70), this requires interpolation to derive criteria intermediate to Ecoregions 69 and 70.
3. If the point-estimated background conductivity is ≥ 136 and the CI for the

estimated background of Ecoregion 68 overlaps with 136-210 µS/cm (the CI range for estimated background conductivity in Ecoregion 70), the criteria for Ecoregion 70 are applicable to Ecoregion 68.

4. If the lower CI for the estimated background conductivity of Ecoregion 68 is >210 µS/cm (upper CI for Ecoregion 70), the existing criteria (for Ecoregion 69 and 70) are not applicable and a new criteria would be more appropriate.

Based on these rules, the criteria developed for Ecoregion 69 are applicable to the Southwestern Appalachians (Ecoregion 68) because the estimated background in Ecoregion 68 is less than the background in the Central Appalachians (Ecoregion 69) and substantially less than in the Western Allegheny Plateau (Ecoregion 70). This finding was validated with EPA datasets and an independent dataset composed of data collected by state agencies in KY, TN, and AL in Ecoregion 68.

Background conductivity for the ionic mixture (($[HCO_3^-] + [SO_4^{2-}]$) < $[Cl^-]$ in mg/L), estimated as the 25th centile of the average conductivity of sites from the EPA-combined data set in Ecoregion 68, is 45 µS/cm (95% CI 31- 61 µS/cm, $N = 46$, no replicates) (Table 6.4). Background conductivity for the same mixture, estimated as the 25th centile of the average conductivity in sites from the State-combined data set in Ecoregion 68, is 50 µS/cm (95% CI 42-64 µS/cm, $N = 188$ sites, 294 samples, replicate samples for a site were averaged) (Table 6.4). Because the estimated background conductivity from the EPA-combined data set and the State-combined data set are below the upper CI for the estimated background for Ecoregion 69 (Table 6.4; Section 4.4.2), the criteria developed for Ecoregion 69 (CCC = 300 µS/cm, CMEC = 614 µS/cm) are applicable throughout Ecoregion 68 wherever conductivity is elevated due to salts dominated by $HCO_3^- + SO_4^{2-}$ (mg/L).

Table 6.4. Background Conductivity Estimates for Ecoregions 68 and 69 expressed as µS/cm.

Data set	Centile(s) Used to Estimate Background	Estimated Background[a]	Confidence Interval	Number of Sites	Number of Samples
EPA-combined dataset from Ecoregion 68	25th of probability sites	45	31-61	46	46
State-combined dataset from Ecoregion 68	25th of probability sites	50	42-64	188	294
Ecoregion 69, Criterion derivation dataset	25th centile of probability sites, 75th of reference sites	63-94	60-101 inclusive CI[b]	varies	varies
Ecoregion 70, Criterion derivation dataset	25th centile of probability sites, 75th of reference sites	147-201	136-210, inclusive CI	varies	varies

[a] The average of replicate samples for a site was used to estimate background.
[b] Inclusive CI is the lowest and highest CI associated with background estimates for an Ecoregion using a variety of methods, e.g., 25th centile of probability sites, 75th of reference sites.

6.3. VERIFICATION RESULTS

Because this is the first demonstration of applicability of an existing criterion to a new ecoregion using the background of the ionic mixture as the only predictor (i.e., background-matching method described in 3.6), the approach was verified as reliable for identifying a pre-existing and applicable criterion by estimating the HC_{05} from the State-combined dataset.

Using the background-matching approach, the criteria developed with data from Ecoregion 69 were found to be applicable for Ecoregion 68 (Section 6.2.2). In this section, that background-matching approach and results are verified by deriving an HC_{05} for Ecoregion 68 using the State-combined data set (Section 6.1.2). In this way, the background-matching approach is demonstrated to be a reasonable method because the estimated HC_{05} is similar to the applicable criteria assigned based on the background-matching approach.

The estimated HC_{05} calculated here is for verification purposes only and is not necessarily a recommended WQC due the limited size of data sets. Sensitivity analyses indicate that about 500 samples are necessary to achieve consistent results with regard to HC_{05} derivation (Section 4.3.1, Section 5.3.1, and EPA 2011a). In the State-combined data set there are 294 samples at 188 stations (Table 6.2). (The State-combined data set was used for this analysis rather than the EPA-combined data set owing to its larger size). Replicate samples represent 36% of samples. Four sites did not have any taxa that met minimum requirements for estimating an XC_{95} value thereby reducing the data set to 184 stations. Of the 432 taxa, only 114 are identified to the genus-level and occur ≥25 times. Although some sampling methods would tend to collect different types of genera, the large variety of represented taxa indicates that aquatic life are well represented in the State-combined data set. Different methods are randomly represented in streams throughout the tested range of conductivity levels and therefore do not bias the results.

The estimated HC_{05} from the State-combined data set for Ecoregion 68 is 247 µS/cm (95% CI 164-304 µS/cm) (Fig 6.4). This estimated HC_{05} is within the confidence bounds of the HC_{05} of Ecoregion 69 (305 µS/cm, 95% CI 233-329 µS/cm). These findings verify that the background-matching approach for determining applicability is a reasonable approach because the 95% confidence intervals of the estimated HC_{05} and the assigned criterion overlap. Therefore, the conductivity criteria developed for Ecoregion 69 is further supported as the applicable criteria for Ecoregion 68.

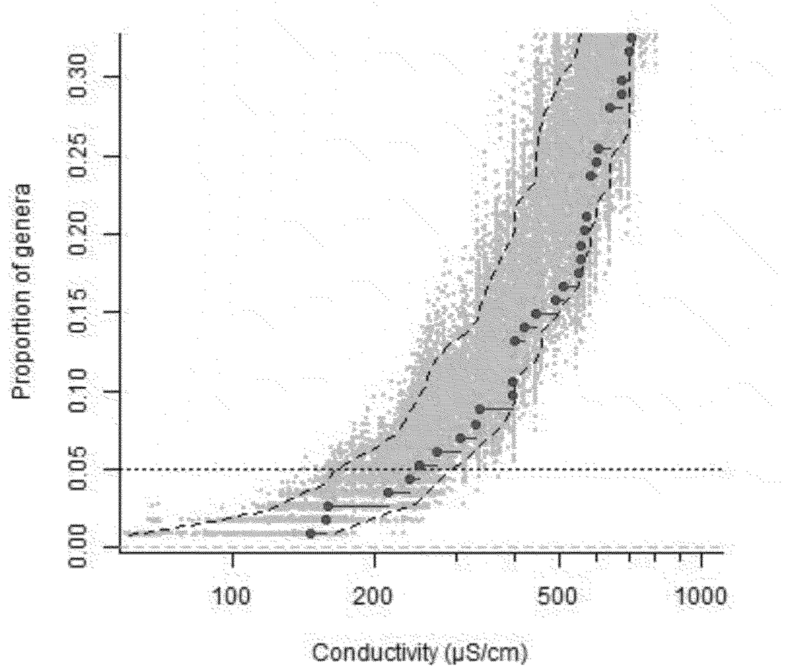

Figure 6.4. Cumulative distribution of the XC_{95} values for the 36 most sensitive genera (blue circles) and 95% confidence intervals (dotted lines) based on 1000 bootstrapping results. Each small grey dot represents an SSD probability for each bootstrapping iteration. Each larger dark dot represents the median SSD. The State-combined data set was used for this analysis rather than the EPA-combined data set owing to its larger size.

6.4. ECOREGION 68: CRITERION CHARACTERIZATION

6.4.1. Ecoregion 68: CCC and CMEC

Numeric criteria include magnitude (i.e., how much), duration (i.e., how long), and frequency (i.e., how often) components. Appropriate duration and frequency components of criteria are determined based on consideration of available data and understanding the exposure-response relationship in the context of protecting the designated use of a water body. The significant consideration used in setting the duration component of aquatic life criteria is how long the exposure concentration can be above the criteria without affecting the endpoint on which the criteria are based (Stephan et al. 1985; U.S. EPA 1991). As described below, EPA is recommending an annual geometric mean (i.e., CCC) and a 1-day mean (i.e., CMEC), which are not to be exceeded more than once in three years on average (Table 6.5). It would be necessary to meet both of these distinct expressions of the conductivity criterion in order to adequately protect aquatic life.

6.4.2. Ecoregion 68: Criterion Continuous Concentration (CCC)

The CCC for conductivity that is applicable in Ecoregion 68 is the CCC of 300 µS/cm developed for conductivity in Ecoregion 69 which is based on an HC_{05} point estimate (i.e., conductivity level associated with extirpation of 5% of the local macroinvertebrate genera rounded to two significant figures). The recommended duration for the CCC is one year (i.e., an annual geometric mean of 300 µS/cm). EPA recommends a return frequency of no more than once in three years to provide adequate protection of aquatic life in flowing waters in Ecoregions 68.

6.4.3. Ecoregion 68: Criterion Maximum Exposure Concentration (CMEC)

The CMEC is the maximum concentration that occurs while meeting the CCC 90% of the time. The method for calculating the CMEC is described in Section 3.2. Using the applicable criterion from Ecoregion 69 that value is the CMEC 620 µS/cm (rounded to two significant figures) (Section 4.2.2). The recommended duration for the CMEC is one day (i.e., daily average). EPA recommends a return frequency of no more than once in three years to provide adequate protection of aquatic life in flowing waters in Ecoregions 68.

6.4.4. Ecoregion 69: Applicable Waterbody Types

EPA is recommending this chronic conductivity criterion for all flowing waters within the study area including perennial, intermittent and ephemeral streams and larger streams. The chronic criteria were developed from data collected in catchments ranging from 0.34 km^2 to 17985 km^2; therefore, EPA is recommending this chronic cronductivity criterion for all flowing waters of all drainage sizes represented in the Ecoregion 69 data set. However, EPA recommends using professional judgment when applying the criterion to streams crossing ecoregional boundaries and stream catchments draining >1000 km^2 because they are less well represented in the data set. EPA also proposes to extend the recommended chronic conductivity criteria to ephemeral streams where such streams are connected to intermittent or perennial streams in order to protect downstream aquatic life. Discharge to ephemeral streams ultimately affects downstream intermittent/perennial streams (via gravity and flow through the tributary system during precipitation events). As a result, addressing conductivity in upstream ephemeral streams is often critical to ensuring that downstream aquatic life is not exposed to harmful levels of conductivity above the criterion level. Therefore, the CCC and CMEC for conductivity are applicable to streams and rivers of all drainage sizes represented in the data set; however, EPA recommends using professional judgment when applying the criterion to streams crossing ecoregional boundaries and stream catchments draining >1000 km^2 (Figure 2.4).

6.4.5. Ecoregion 68: Applicable Geographic Region

EPA is recommending use of these conductivity criteria throughout the Southern Appalachians (Ecoregion 68) (Omernik 1987). Because the estimated background conductivity throughout Ecoregion 68 is less than the upper 95% confidence interval for the background estimated from the Ecoregion 69 criterion data set (See Section 4.1), the criteria (CCC = 300 µS/cm, CMEC = 620 µS/cm) are applicable throughout Ecoregion 68 where the ionic mixture is dominated by $HCO_3^- + SO_4^{2-}$ (mg/L). However, care should be taken to determine whether a particular water body has naturally high salinity tributaries due to salt springs, highly soluble rock, or other sources or high conductivity due to other ionic mixtures such as chloride salts.

6.4.6. Ecoregion 68: Protection of Endangered Species

Although the draft recommended criteria are based solely on macroinvertebrate taxa represented in the data sets, the available evidence indicates that other taxa in the streams are likely to be protected as well (Section 3.2.11). Hence, no adjustment was made for unanalyzed taxa. However, on a site-specific basis, alternative criteria may be necessary to protect important species, highly valued aquatic communities, or specially protected waters (see Appendix #).

6.5. ECOREGION 68: SUMMARY: CONDUCTIVITY CRITERIA RECOMMENDATION

Freshwater animals would have an appropriate level of protection if the annual geometric mean conductivity concentration does not exceed 300 µS/cm and the 1-day mean does not exceed 620 µS/cm, more than once every three years on average (Table 6.5).

Table 6.5. Summary Conductivity Criteria for Ecoregion 68

	CCC	CMEC
Magnitude	300 µS/cm	620 µS/cm
Duration	1 year	1 day
Frequency	No more than once every three years on average	
Geographic Region	Ecoregion 68 inclusive of KY, TN, AL	
Waterbody Type	All flowing fresh waters	

6.6. REFERENCES (NOTE PARTIAL LIST, NEEDS TO BE COMPLETED)

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